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AUTHOR Bloch, Erich
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ABSTRACT

The role of the National Science Foundation (NSF) in supporting college science and engineering education at the undergraduate level is discussed, along with important factors in the national environment, including economic challenges facing the country, and the foundation's relationship to research and education. Because of a shift to a global economy in which there is sharp international competition, it is in the nation's interest to strengthen science education; however, there is a shortage of engineers, scientists, and mathematicians with advanced degrees to staff colleges and government and industry laboratories. Attracting students into these fields is an important policy issue. NSF has a new program to provide instructional equipment to colleges. To develop scientific and technical talent, NSF sponsors the Research in Predominantly Undergraduate Institutions Program. For faculty, there are opportunities to join an existing NSF-supported project or to serve on NSF review panels, advisory committees, and rotator program officer positions. A special committee of NSF is conducting public hearings on the state of undergraduate science and engineering education. The federal research and development budget for the mid-1980s is briefly discussed. (SW)

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REMARKS OF MR. ERICH BLOCH
DIRECTOR, NATIONAL SCIENCE FOUNDATION

TO THE AMERICAN COUNCIL ON EDUCATION
MIAMI BEACH, FLORIDA
OCTOBER 30, 1985

"THE FEDERAL ROLE IN UNDERGRADUATE SCIENCE AND ENGINEERING EDUCATION"

THANK YOU FOR INVITING ME TO ADDRESS THE COUNCIL.

I AM DELIGHTED TO SPEAK ABOUT UNDERGRADUATE SCIENCE EDUCATION. IT IS A SUBJECT OF PARTICULAR INTEREST TO ME, NOT JUST AS THE DIRECTOR OF A FEDERAL AGENCY WITH A SPECIAL ROLE IN SCIENCE EDUCATION BUT BECAUSE, LIKE MOST ENGINEERS, MY FORMAL EDUCATION ENDED WITH THE UNDERGRADUATE DEGREE.

IN MY REMARKS TODAY, I WILL SUGGEST SOME THINGS THAT YOU, AS LEADERS OF UNDERGRADUATE INSTITUTIONS, COULD BE DOING TO STRENGTHEN YOUR EFFORTS IN SCIENCE AND ENGINEERING RESEARCH AND EDUCATION.

I WILL MENTION WHAT THE NATIONAL SCIENCE FOUNDATION IS DOING, COMMENT ON THE FOUNDATION'S CURRENT ROLE IN UNDERGRADUATE EDUCATION, AND DESCRIBE OUR EFFORTS TO EXAMINE THAT ROLE.

BUT JUST TALKING ABOUT THE SUBJECT WITHOUT SETTING IT IN CONTEXT WOULD NOT DO IT JUSTICE. WE NEED TO UNDERSTAND THE OVERALL NATIONAL ENVIRONMENT. THEREFORE, I WOULD LIKE TO BEGIN BY COMMENTING ON THE ECONOMIC CHALLENGE FACING OUR NATION TODAY, AND ITS RELATIONSHIP TO RESEARCH AND EDUCATION.

THE MOST STRIKING AND PERVASIVE CHANGE OF THE 1980'S -- ONE THAT IS FUNDAMENTAL AND IRREVERSIBLE -- IS THE SHIFT TO A GLOBAL ECONOMY. THE NEW WORLDWIDE ECONOMY FEATURES SHARPER INTERNATIONAL COMPETITION, ESPECIALLY IN AREAS OF TECHNOLOGY WHERE THE UNITED STATES HAS BEEN PRE-EMINENT SINCE WORLD WAR II. I NEED ONLY MENTION THE CHALLENGES OF THE LAST FEW YEARS TO THE NATION'S AUTOMOTIVE INDUSTRY, ITS CONSUMER ELECTRONICS INDUSTRY -- AND OF LATE ITS SEMICONDUCTOR INDUSTRY. THE SUCCESS OF THE JAPANESE IN MANUFACTURING AND MARKETING HAS HAD RAPID AND SWEEPING EFFECTS ON OUR INDUSTRIAL BASE.

JAPAN IS NOT THE ONLY NEW COMPETITOR FOR WORLD LEADERSHIP IN CERTAIN TECHNOLOGIES. SOUTH KOREA AND OTHER PACIFIC RIM NATIONS ARE RIGHT BEHIND JAPAN.

OTHER COUNTRIES SUCH AS BRAZIL AND INDIA ARE ALSO ASPIRING TO A MAJOR POSITION IN SPECIFIC AREAS OF TECHNOLOGY BY THE END OF THE CENTURY. AND THEY HAVE THE POTENTIAL TO DO SO.

AS THE REPORT OF THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS POINTED OUT EARLIER THIS YEAR, OTHER NATIONS HAVE CONSIDERABLE ADVANTAGES IN WORLD COMPETITION THAT ARE NOT EASY FOR US TO OVERCOME. CHEAPER LABOR AND LOWER INTEREST RATES ARE TWO OF THEIR STRONGEST ADVANTAGES. AND SOME COUNTRIES HAVE ADDITIONAL ONES -- SUCH AS THE WAY THEY PROTECT THEIR INDUSTRIES FROM FOREIGN COMPETITION.

BUT THE UNITED STATES ALSO HAS TWO CLEAR ADVANTAGES IN INTERNATIONAL COMPETITION: FIRST, THE FLOW OF FRESH IDEAS AND DISCOVERIES FROM RESEARCHERS IN UNIVERSITIES, COMPANIES AND GOVERNMENT AGENCIES; SECOND, OUR LARGE, DIVERSE, FLEXIBLE POOL OF HUMAN RESOURCES THROUGH WHOM ENTREPENEURS CAN CAPITALIZE ON DISCOVERIES, CREATE NEW TECHNOLOGIES, AND MARKET THEM -- AND THAT ALSO SERVES THE ESTABLISHED AND GROWING COMPANIES, THE GOVERNMENT AND ACADEMIA.

THE ONLY WAY THAT WE CAN KEEP AHEAD OF OTHER COUNTRIES IS BY CONTINUING TO KEEP NEW IDEAS FLOWING THROUGH RESEARCH AND BY CONTINUING TO HAVE THE BEST TECHNICALLY-TRAINED, MOST INVENTIVE AND ADAPTABLE WORKFORCE OF ANY NATION. THAT IS THE FUNDAMENTAL REASON WHY A GOOD EDUCATION IN SCIENCE, MATHEMATICS AND TECHNOLOGICAL SUBJECTS IS SO IMPORTANT -- NOT ONLY FOR UNDERGRADUATES, OF COURSE, BUT THROUGHOUT THE EDUCATIONAL SYSTEM, BEGINNING IN THE PRIMARY GRADES.

THE NATION AS A WHOLE MUST STEP UP ITS EFFORTS TO ATTRACT AND EDUCATE THOSE WHO WILL BE CRITICAL TO OUR TECHNOLOGICAL FUTURE -- THE THOUSANDS OF SCIENTISTS AND ENGINEERS FOR RESEARCH IN EVERY FIELD, AND THE HUNDREDS OF THOUSANDS OF TECHNICIANS AND OTHER SUPPORT PEOPLE, WHO ARE VITAL FOR OUR SOCIETY TO FUNCTION.

A SECOND REASON WHY IT IS IN THE NATION'S INTEREST TO STRENGTHEN SCIENCE EDUCATION IS THAT AMERICA WILL ALWAYS HAVE TO DEAL WITH COMPLEX ENVIRONMENTAL, ECONOMIC AND ETHICAL ISSUES THAT REQUIRE A FAIR DEGREE OF UNDERSTANDING OF THE SCIENCE INVOLVED. SUCH DIFFICULT PUBLIC ISSUES AS TOXIC WASTES, NUCLEAR WINTER AND ACID RAIN WILL STILL NEED TO BE DEALT WITH IN THE DECADES TO COME. AND NO DOUBT THEY WILL BE JOINED BY NEW ISSUES ARISING FROM BIOTECHNOLOGY AND MEDICINE, AND FROM STILL UNKNOWN DISCOVERIES IN MANY OTHER FIELDS.

SO THE NATION DEPENDS UPON ITS UNDERGRADUATE COLLEGES TO PROVIDE A HIGH QUALITY EDUCATION IN SCIENCE, MATHEMATICS AND TECHNICAL SUBJECTS:

-- TO THE RELATIVELY SMALL NUMBER WHO WILL GO ON TO PURSUE THE DOCTORATE;

-- TO THE LARGER NUMBER WHO WILL GO INTO TEACHING, ENGINEERING, OR ANY OF THE TECHNICAL SPECIALTIES IN INDUSTRY;

-- AND TO THE MANY OTHERS WHO WILL BECOME LEADERS OF INDUSTRY, GOVERNMENT, UNIVERSITIES, MEDIA AND PUBLIC INTEREST GROUPS.

WE NEED STRONG EDUCATIONAL PROGRAMS IN SCIENCE AND ENGINEERING FOR STUDENTS IN ALL OF THESE CATEGORIES; BUT IT IS PARTICULARLY NECESSARY TO INCREASE THE NUMBER OF PERSONS WHO WILL GO ON TO AN ADVANCED DEGREE IN SCIENCE OR ENGINEERING.

THE NATION IS SHORT OF ADVANCED DEGREED ENGINEERS TO STAFF OUR FACULTIES AND OUR GOVERNMENT AND INDUSTRY LABORATORIES -- YET OUR PRODUCTION OF PH.D. GRADUATE ENGINEERS IS NOT INCREASING.

AND THIS IS TRUE NOT ONLY OF ENGINEERS:

-- THE PRODUCTION OF DOCTORATES IN THE PHYSICAL SCIENCES FELL OFF SHARPLY IN THE 1970'S AND HAS NOT RECOVERED;

-- AND THE NUMBER OF NEW PH.D'S EACH YEAR IN MATHEMATICS FELL BY ABOUT 30 PERCENT FROM 1974 TO 1984.

MOREVER, A HIGH PROPORTION OF RECENT PH.D. GRADUATES ARE NOT FROM THE UNITED STATES. FOREIGN NATIONALS NOW RECEIVE OVER HALF OF U.S. PH.D. DEGREES IN ENGINEERING, UP FROM ABOUT A QUARTER TWENTY YEARS AGO. IN FACT, ALMOST ALL RECENT GROWTH IN GRADUATE SCIENCE ENROLLMENTS HAS COME FROM FOREIGN STUDENTS.

NOW, THAT MAY BE A GOOD SITUATION, ESPECIALLY BECAUSE SIXTY PER CENT ARE STAYING HERE AND JOINING OUR WORKFORCE. THEY ARE A VITAL ELEMENT IN ACADEMIA, INDUSTRY AND THE GOVERNMENT. BUT I THINK WE MUST BE CLEAR ABOUT THE FACT THAT IN MANY FIELDS WE ARE DEVELOPING AN OVERDEPENDENCE ON FOREIGN STUDENTS FOR TEACHING, RESEARCH AND THE GENERAL WORKFORCE. IT IS ENTIRELY POSSIBLE THAT THIS SOURCE OF TALENT COULD BE INTERRUPTED WITH VERY LITTLE ADVANCE NOTICE AND FOR REASONS THAT ARE ENTIRELY BEYOND THE CONTROL OF SCIENCE AND EDUCATION POLICY-MAKERS -- OR OF OUR GOVERNMENT.

WE NEED TO MAKE SURE THAT PURSUING THE Ph. D. TRACK IN THE PHYSICAL SCIENCES AND ENGINEERING IS NOT BECOMING AN UN-AMERICAN ACTIVITY!

TO COMPLICATE MATTERS, THE POOL OF POTENTIAL STUDENTS FROM U.S. SCHOOLS WILL BECOME SMALLER. DEMOGRAPHIC PROJECTIONS OF WHICH YOU ARE ALL AWARE SHOW THE NUMBER OF 18-24 YEAR OLDS DECLINING BY ABOUT 20% OVER THE NEXT DECADE. UNLESS A MUCH HIGHER PROPORTION OF THEM BECOME INTERESTED IN PURSUING A MAJOR IN SCIENCE OR ENGINEERING, ENROLLMENTS IN THESE FIELDS WILL DECREASE GREATLY AT THE UNDERGRADUATE LEVEL IN A FEW YEARS.

SO ONE OF THE MOST IMPORTANT POLICY ISSUES FOR UNDERGRADUATE SCIENCE AND ENGINEERING EDUCATION IS: HOW CAN WE ATTRACT A MUCH HIGHER PROPORTION OF FRESHMEN FROM U.S. HIGH SCHOOLS TO SCIENCE, MATHEMATICS AND ENGINEERING -- AND HOW CAN WE PROVIDE THEM WITH THE BEST EDUCATION THROUGHOUT THEIR UNDERGRADUATE YEARS? A RELATED POLICY ISSUE IS: HOW CAN WE INDUCE MORE PERSONS FROM UNDERUTILIZED GROUPS (WOMEN AND MINORITIES) TO TURN TOWARD SCIENCE AND ENGINEERING?

INTEREST IN SCIENTIFIC SUBJECTS USUALLY BEGINS LONG BEFORE STUDENTS ENTER COLLEGE. STUDIES HAVE SHOWN AGAIN AND AGAIN THAT MOST STUDENTS WHO GO ON TO BECOME SCIENTISTS OR ENGINEERS DEVELOP THEIR INTERESTS -- AND AN IDEA OF THEIR OWN COMPETENCE -- IN ELEMENTARY, MIDDLE AND HIGH SCHOOL YEARS. PERHAPS IT IS MORE ACCURATE TO TURN THAT AROUND AND SAY THAT MOST STUDENTS ARE "TURNED OFF" TO SCIENCE IN THOSE EARLY YEARS DUE TO A POOR EDUCATION OR BECAUSE THEY COME TO BELIEVE THAT IT'S JUST TOO DIFFICULT OR REMOTE FOR THEM.

YOUR INSTITUTIONS, THEN, MUST STRIVE TO DEVELOP MORE AND BETTER LINKS WITH HIGH SCHOOLS AND JUNIOR HIGH SCHOOLS. IN ADDITION TO CONTINUING EDUCATION OR SUMMER PROGRAMS FOR TEACHERS, PERHAPS YOU COULD HELP THEM IN SOME OTHER WAYS -- OPENING UP YOUR LAB FACILITIES FOR A TOUR BY TENTH-GRADERS; OR ASKING SOME OF YOUR BETTER SCIENCE TEACHERS TO SPEND ONE DAY A SEMESTER VISITING A COUPLE OF NINTH-GRADE CLASSES.

BUT ONCE STUDENTS ENTER COLLEGE, WHAT CAN BE DONE TO SUSTAIN THEIR INTEREST AND BUILD COMPETENCE?

I HAVE OBSERVED, AND BEEN TOLD BY EDUCATORS AND STUDENTS, THAT THE BEST WAY IS TO OFFER SOME GENUINELY INTERESTING LABORATORY COURSES IN FRESHMAN AND SOPHOMORE YEARS. BUT SOME SCHOOLS HAVE WATERED DOWN LAB COURSES OR SUBSTITUTED NON-LAB COURSES, BECAUSE THEY DON'T HAVE ADEQUATE FACILITIES OR INSTRUCTORS -- OR BECAUSE MANY STUDENTS CONSIDER LAB COURSES TOO DIFFICULT.

I KNOW A LOT HAS CHANGED IN EDUCATION SINCE I WENT TO SCHOOL, BUT I CAN'T SEE HOW THERE WILL EVER BE ANY SUBSTITUTE FOR "HANDS-ON" LABORATORY EXPERIENCE IN A SMALL GROUP TAUGHT BY A COMPETENT, INTERESTED INSTRUCTOR.

IN SHORT, ATTRACTING MORE OF OUR BEST PEOPLE TO SCIENCE AND ENGINEERING AND PROVIDING THEM WITH A ROBUST EDUCATION IS A PRIORITY FOR OUR COUNTRY.

NOW I WOULD LIKE TO TURN TO SOME NSF ACTIVITIES AND PROGRAMS IN UNDERGRADUATE EDUCATION. TO ATTACK THE PROBLEM OF MODERNIZING LABORATORIES, THE FOUNDATION HAS A NEW PROGRAM TO PROVIDE INSTRUCTIONAL EQUIPMENT TO COLLEGES. WE MADE MORE THAN FIVE MILLION DOLLARS IN AWARDS THIS YEAR, AND THAT IS A FAIR START, BUT THE PROGRAM IS IN HIGH DEMAND, AND I CERTAINLY HOPE WE WILL BE ABLE TO RAISE THAT FUNDING LEVEL IN FUTURE YEARS.

ONCE YOUR STUDENTS GO ON TO THEIR THIRD OR FOURTH YEARS, I THINK THE BEST WAY TO BETTER PREPARE THEM TO UNDERTAKE GRADUATE WORK IS BY INCREASING OPPORTUNITIES TO PARTICIPATE IN RESEARCH ACTIVITIES.

NSF RECOGNIZES THE IMPORTANCE OF RESEARCH AT UNDERGRADUATE INSTITUTIONS, AND THE LINK TO DEVELOPING SCIENTIFIC AND TECHNICAL TALENT THROUGH OUR RESEARCH IN PREDOMINANTLY UNDERGRADUATE INSTITUTIONS PROGRAM (RUI). WE MADE THAT RECOGNITION MORE EXPLICIT TWO YEARS AGO BY ESTABLISHING A SPECIAL, ACROSS-THE-BOARD EFFORT TO INCREASE PARTICIPATION AND SUPPORT OF UNDERGRADUATE INSTITUTIONS IN OUR RESEARCH PROGRAMS -- WITHOUT COMPROMISING THE HIGH STANDARD OF COMPETITIVE REVIEW THAT IS THE FOUNDATION'S HALLMARK.

LET ME TELL YOU A LITTLE BIT ABOUT THIS EFFORT: AS YOU KNOW, MOST OF THE FOUNDATION'S RESEARCH SUPPORT DIVISIONS ARE RESPONSIBLE FOR SEEING TO THE VITALITY OF A PARTICULAR DISCIPLINE. RATHER THAN CHANGING THIS STRUCTURE, WE DEVISED A WAY TO MANAGE, TRACK AND FUND PROPOSALS FROM UNDERGRADUATE INSTITUTIONS ACROSS THE EXISTING ORGANIZATION.

HERE'S HOW WE'VE DONE SO FAR:

IN FISCAL 1983, BEFORE THIS SPECIAL EFFORT BEGAN, WE SUPPORTED ABOUT $29 MILLION OF RESEARCH IN PREDOMINANTLY UNDERGRADUATE INSTITUTIONS. IN FISCAL 1984, THE FIRST YEAR OF THE PROGRAM, THE TOTAL AWARDED WAS SOME $41 MILLION -- AN INCREASE OF 40%, AND WELL ABOVE OUR TARGET.

IN FISCAL 1985, JUST COMPLETED IN SEPTEMBER, THE TOTAL WAS $47 MILLION, A FURTHER INCREASE OF ROUGHLY 15% OVER 1984.

THESE PERCENTAGE INCREASES ARE SIGNIFICANTLY HIGHER THAN THE INCREASES IN NSF'S OVERALL BUDGETS FOR THOSE YEARS; AND WE WILL SOON BE SETTING TARGETS FOR THIS CURRENT FISCAL YEAR.

I SHOULD ADD THAT ABOUT A THIRD OF PROPOSALS FROM UNDERGRADUATE INSTITUTIONS ARE FUNDED. THAT COMPARES FAVORABLY WITH THE PROPORTION FOR SIMILAR SINGLE-INVESTIGATOR PROJECTS FROM THE MAJOR UNIVERSITIES.

ALTHOUGH THE MAJOR RESEARCH INSTITUTIONS GET THE MAJORITY OF NSF AWARDS, THE SUBSTANTIAL FUNDING INCREASES I JUST MENTIONED DEMONSTRATE THAT MUCH GOOD RESEARCH CAN BE DONE OUTSIDE THE GRADUATE RESEARCH UNIVERSITIES -- AND THAT NSF RECOGNIZES THAT FACT.

BECAUSE GOOD RESEARCH IDEAS CAN COME FROM EVERYWHERE, WE INTEND TO KEEP THE SYSTEM OPEN TO PROPOSALS FROM THE WHOLE RANGE AND BREADTH OF ACADEMIC INSTITUTIONS, IN EVERY PART OF THE NATION, AND TO CONTINUE ENCOURAGING RESEARCHERS AT UNDERGRADUATE INSTITUTIONS TO COME FORWARD AND APPLY.

WE ALSO HAVE A VERY IMPORTANT EFFORT OF A DIFFERENT SORT, ONE THAT I HOPE YOUR FACULTY ARE TAKING ADVANTAGE OF, AND THAT IS: THE OPPORTUNITY TO JOIN AN EXISTING NSF-SUPPORTED PROJECT IN ANY FIELD OF RESEARCH AND AT ANY INSITUTION -- SIMPLY BY REQUESTING OR HAVING THE PRINCIPAL INVESTIGATOR REQUEST THAT A FACULTY PERSON FROM AN UNDERGRADUATE INSTITUTION BE ADDED TO THE GRANT.

BASICALLY, ALL IT TAKES TO APPLY FOR RESEARCH OPPORTUNITY AWARDS (ROA'S) IS A BRIEF LETTER TO THE NSF PROGRAM OUTLINING THE PERSON'S INTEREST, QUALIFICATIONS, AND PROJECTED EXPENSES. IF IT IS AGREEABLE TO THE P.I. AND THE INSTITUTION, WE WILL THEN SUPPLEMENT THE GRANT BUDGET, WITHOUT EXTENSIVE REVIEW. IT IS A GOOD WAY FOR YOUR FACULTY TO REFRESH THEIR EXPERIENCE WITH SOME FOREFRONT RESEARCH WORK -- AND TO PREPARE THEMSELVES TO SUBMIT A PROPOSAL OF THEIR OWN.

BY THE WAY, WE CONTINUE TO ENCOURAGE YOUR FACULTY TO SERVE ON OUR REVIEW PANELS AND ADVISORY COMMITTEES AND TO SEEK OUT POSITIONS ON OUR STAFF AS "ROTATOR" PROGRAM OFFICERS WHO SERVE ONE OR TWO YEARS AND RETURN TO THEIR COLLEGES. BOTH TYPES OF SERVICE ARE EXCELLENT WAYS TO LEARN MORE ABOUT HOW THE SYSTEM OPERATES, TO GET A CLEARER PICTURE OF WHERE THE RESEARCH FRONTIERS ARE, AND TO INFLUENCE THE PROGRAMMATIC ASPECTS OF NSF. I KNOW THAT THE NUMBER OF REVIEWERS AND PANELISTS FROM UNDERGRADUATE INSTITUTIONS IS RELATIVELY SMALL, BUT IT HAS NEARLY DOUBLED SINCE I'VE BEEN DIRECTOR, AND MY STAFF HAS BEEN INSTRUCTED TO INCREASE IT WHEREVER POSSIBLE.

THE VARIOUS EFFORTS I JUST DESCRIBED -- STEPPING UP SUPPORT OF RESEARCH AWARDS, ADDING RESEARCHERS TO PROJECTS, AND INCREASING REPRESENTATION ON OUR PANELS, COMMITTEES AND STAFF -- DEMONSTRATE THE FOUNDATION'S CONCERN FOR UNDERGRADUATE INSTITUTIONS. THESE EFFORTS FURTHER THE NSF'S PRINCIPAL OBJECTIVE OF GENERATING THE SCIENTIFIC AND ENGINEERING TALENT THAT THE NATION WILL NEED TO SUSTAIN ITS FUTURE COMPETITIVENESS.

WE ARE CONVINCED THAT THE MOST EFFECTIVE WAY TO ACHIEVE THAT OBJECTIVE IS FOR THE FOUNDATION TO SUPPORT RESEARCH, AND THROUGH RESEARCH ENHANCE AND FOSTER THE EDUCATION OF EVERYONE WHO COMES IN CONTACT WITH IT -- AND TO MAKE SURE THAT THE SYSTEM REMAINS AN OPEN AND FAIR ONE THAT ACCEPTS PROPOSALS AND IDEAS FROM EVERY SOURCE.

THE FOUNDATION IS RIGHT NOW ACTIVELY AND CAREFULLY CONSIDERING THE STATE OF UNDERGRADUATE SCIENCE AND ENGINEERING EDUCATION. A SPECIAL COMMITTEE OF THE NATIONAL SCIENCE BOARD (CHAIRED BY DR. HOMER NEAL, PROVOST OF THE STATE UNIVERSITY OF NEW YORK AT STONY BROOK) IS CONDUCTING PUBLIC HEARINGS ON THIS TOPIC. TWO HEARINGS HAVE BEEN COMPLETED, AND TWO MORE ARE PLANNED. I SHOULD POINT OUT THAT IT IS VERY UNUSUAL FOR THE BOARD TO HOLD EXTENSIVE PUBLIC HEARINGS, WHICH BY ITSELF DEMONSTRATES THE IMPORTANCE THAT WE ARE GIVING TO THIS SUBJECT.

A VARIETY OF LEADERS OF ACADEMIC INSTITUTIONS, INDUSTRY AND GOVERNMENT HAVE APPEARED AS WITNESSES, OR ARE SCHEDULED TO APPEAR. IN ADDITION, THE COMMITTEE HAS SOUGHT AND RECEIVED A NUMBER OF LETTERS AND REPORTS FROM ORGANIZATIONS AND INDIVIDUALS. THE COMMITTEE INTENDS TO PRESENT ITS RECOMMENDATIONS TO THE FULL SCIENCE BOARD IN JANUARY. I CANNOT PREDICT PRECISELY WHAT THOSE RECOMMENDATIONS WILL BE -- MUCH LESS HOW THEY WILL FIT INTO THE FISCAL 1987 BUDGET WHEN IT GOES TO THE CONGRESS IN JANUARY -- BUT I DO WANT TO ASSURE YOU THAT WE ARE LISTENING AND LEARNING, AND PAYING ATTENTION TO THE ISSUES.

WE APPRECIATE THE ROLE THE AMERICAN COUNCIL ON EDUCATION AND THE OTHER ASSOCIATIONS AND SOCIETIES ARE PLAYING IN THIS PROCESS. I HAVE READ YOUR LETTER TO DR. NEAL, AND WHILE HIS COMMITTEE WILL DEAL WITH YOUR REPORT, I WANT TO GIVE YOU SOME STRICTLY PERSONAL OBSERVATIONS:

FIRST, YOUR PRIORITY ONE, UNDERGRADUATE INSTRUCTION EQUIPMENT AND MATERIALS, IS IN LINE WITH OUR OWN THINKING, AND WE ALSO CONCUR THAT INCREASES IN THIS AREA ARE REQUIRED.

SECOND, YOUR PROPOSAL TO EXPAND SUPPORT ACROSS THE DIRECTORATES IS IN LINE WITH THE IMPLEMENTATION I DESCRIBED OF THE NSF'S UNDERGRADUATE INSTITUTIONS PROGRAM AND THE LINKAGE BETWEEN RESEARCH AND EDUCATION IN ALL NSF'S RESEARCH ACTIVITIES.

THIRD, I'D LIKE TO THANK THE REPORT WRITERS FOR THEIR CONFIDENCE IN NSF, IN ASKING US TO INCREASE OUR LEADERSHIP. BUT WE ARE NOT THE ONLY FEDERAL SOURCE FOR SUPPORT OF UNDERGRADUATE EDUCATION. NSF CANNOT BE, AND THE FEDERAL GOVERNMENT CANNOT BE, THE ONLY PLAYERS IN THIS ARENA.

WITH REGARD TO YOUR ASSESSMENT OF THE BUGETARY LEVEL, LET ME UNDERLINE A POINT PRESIDENT FRED STARR MADE AT OUR HEARING: THAT INCREASED SUPPORT FOR UNDERGRADUATE PROGRAMS SHOULD NOT BE AT THE EXPENSE OF THE OTHER RESEARCH AND EDUCATION ACTIVITIES OF NSF. I AGREE.

THE NEXT THREE YEARS WILL BE DIFFICULT BUDGET YEARS. WE MUST LOOK AT THE ENTIRE $53 BILLION FEDERAL R&D BUDGET TO FIND ANY MONEY FOR NEW INITIATIVES OR FOR ADDED EMPHASIS IN EXISTING AREAS, IF WE WANT TO BETTER BASIC RESEARCH AND INFRASTRUCTURE SUPPORT. INCREMENTAL DOLLARS WON'T BE AVAILABLE.

THE CASE FOR REALLOCATION IS COMPELLING. FOR MOST OF THE POST-WAR PERIOD THE PRIMARY RATIONALE FOR FEDERAL SUPPORT OF RESEARCH HAS BEEN THE SUPPORT OF SPECIFIC GOVERNMENT MISSIONS. IN THE EARLY YEARS FOLLOWING THE WAR THIS MEANT THAT MOST RESEARCH SUPPORT IN THE PHYSICAL SCIENCES CAME FROM THE DEPARTMENT OF DEFENSE AND THE ATOMIC ENERGY COMMISSION. IN MORE RECENT YEARS OTHER AGENCIES HAVE BEEN MORE INVOLVED.

THE TROUBLE WITH A SYSTEM THAT RELIES PRIMARILY ON THE MISSION AGENCIES FOR SUPPORT IS THAT IT INTRODUCES A SYSTEMATIC BIAS AGAINST BASIC RESEARCH. EXCEPT FOR THE SPUTNIK ERA IN THE 1960'S, THE FEDERAL GOVERNMENT HAS NOT DONE A VERY GOOD JOB OF SUPPORTING THE OVERALL SCIENCE AND ENGINEERING BASE -- THE RESEARCHERS, EQUIPMENT AND FACILITIES IN UNIVERSITIES AND COLLEGES THAT WE DEPEND ON FOR EDUCATION AND BASIC RESEARCH.

IN THE LAST FOUR YEARS, THE FEDERAL GOVERNMENT HAS STARTED TO RENEW ITS COMMITMENT TO THE SCIENCE AND ENGINEERING BASE. IN THE CIVILIAN PART OF THE FEDERAL R&D BUDGET, DEVELOPMENT HAS DROPPED FROM THE LARGEST PART OF THE R&D EFFORT TO THE SMALLEST, AND BASIC RESEARCH HAS RISEN TO BECOME THE LARGEST COMPONENT. THIS IS AN EXTREMELY IMPORTANT CHANGE.

ON THE DEFENSE SIDE, HOWEVER, BASIC RESEARCH IS A SMALL PART OF THE EFFORT. AND SINCE DEFENSE IS AN INCREASINGLY LARGE PART OF THE FEDERAL R&D EFFORT, THE OVERALL EFFECT IN THE LAST YEAR OR TWO HAS ACTUALLY BEEN A REDUCTION IN THE PROPORTION OF THE FEDERAL R&D DOLLAR THAT GOES TO BASIC RESEARCH.

WE NEED TO GO MUCH FURTHER THAN WE HAVE SO FAR IN REALLOCATING R&D RESOURCES FROM DEVELOPMENT TO SUPPORT OF THE SCIENCE AND ENGINEERING BASE. THE EASIEST WAY, OF COURSE, WOULD BE SIMPLY TO ADD FUNDS TO THE TOTAL. BUT THAT IS NOT REALISTIC IN TODAY'S BUDGET CLIMATE.

WHAT IS NECESSARY IS THAT WE RECOGNIZE THAT THE FEDERAL GOVERNMENT CAN DO SOME THINGS WELL, AND THAT SUPPORT OF THE SCIENCE AND ENGINEERING BASE IS ONE OF THEM. AND IT DOES SOME OTHER THINGS NOT WELL AT ALL -- INCLUDING MAKING DECISIONS ABOUT TECHNOLOGIES THAT SHOULD BE DEVELOPED FOR COMMERCIAL REASONS.

IF WE ARE SUFFICIENTLY TOUGH-MINDED ABOUT CUTTING OUT THE LATTER -- STILL A SIGNIFICANT FRACTION OF THE BUDGET -- THEN WE SHOULD HAVE AVAILABLE THE RESOURCES TO SUBSTANTIALLY INCREASE THE SUPPORT OF BASIC RESEARCH AND THE SCIENCE AND ENGINEERING BASE.

I WOULD LIKE TO SEE SUPPORT FOR THAT BASE INCREASED AT AN ANNUAL RATE OF TEN PERCENT OR SO FOR THE NEXT TEN YEARS. UNLESS WE MAKE THIS TRADEOFF OUR RESEARCH AND EDUCATION EFFORTS WILL NOT BE SUFFICIENT TO STAY AHEAD OF THE ECONOMIC COMPETITION.

LET ME CLOSE NOW BY RETURNING TO THE THEME OF TODAY'S DISCUSSION -- THAT IS, THE FEDERAL ROLE IN UNDERGRADUATE SCIENCE AND ENGINEERING EDUCATION. THERE IS NO QUESTION OF THE IMPORTANCE TO THE NATION OF STRONG EDUCATIONAL ACTIVITIES IN SCIENCE AND ENGINEERING THROUGHOUT ALL LEVELS OF COLLEGES AND UNIVERSITIES, INCLUDING THOSE THAT PRINCIPALLY OFFER THE BACCALAUREATE DEGREE. ALL PARTIES -- THE COLLEGES THEMSELVES, INDUSTRIAL FIRMS, STATE GOVERNMENTS AND THE FEDERAL GOVERNMENT -- MUST CONTRIBUTE TO KEEPING THESE INSTITUTIONS PRODUCTIVE.

I EMPHASIZE THE NOTION OF INVOLVING ALL PARTIES IN PARTNERSHIPS AND COOPERATIVE ARRANGEMENTS, BECAUSE THE FEDERAL GOVERNMENT AND NSF IS LIMITED IN WHAT IT CAN DO -- OR SHOULD DO.

STATE GOVERNMENTS HAVE A PARTICULAR INTEREST IN STRENGTHENING THEIR STATE AND PRIVATE INSTITUTIONS AT EVERY LEVEL. THERE IS A CONSIDERABLE -- AND, I BELIEVE, HEALTHY -- COMPETITION AMONG THE STATES FOR HIGH-TECH INDUSTRY.

MANY STATE GOVERNMENTS REALIZE THE IMPORTANCE OF A WELL-EDUCATED TECHNOLOGICAL WORKFORCE FOR THEIR ECONOMIES. TENNESSEE AND NEW JERSEY, FOR EXAMPLE, HAVE RECENTLY MADE SIGNIFICANT INVESTMENTS IN RESEARCH AND EDUCATION.

AND COMPANIES HAVE A VERY STRONG ROLE TO PLAY HERE AS WELL. MORE OF THEM THAN EVER ARE DEVELOPING PARTNERSHIPS WITH ACADEMIC INSTITUTIONS. THEY BENEFIT VERY DIRECTLY, NOT ONLY FROM THE IDEAS THAT FLOW IN BOTH DIRECTIONS,BUT FROM HAVING ACCESS TO WELL-EDUCATED STUDENTS.

SO I WOULD URGE PRIVATE SECTOR REPRESENTATIVES HERE TODAY TO LEARN MORE ABOUT, AND CONSIDER ENTERING INTO, THE KINDS OF PARTNERSHIP ARRANGEMENTS THAT UNDERGRADUATE INSTITUTIONS ARE PREPARED TO OFFER.

THANK YOU.